Installation and Operation Manual

Installation, Operation, and Service Information

Patent Number for DHT-50 to 125:

6,691,428

Throughout this manual, signal words are present to advise of safety precautions and/or standard practices. Obey these signal words as defined below:

DANGER! - indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

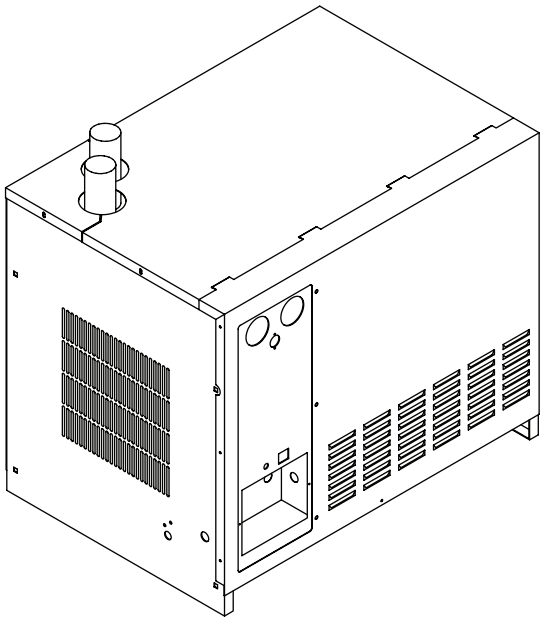
WARNING! - indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION! - indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Notice: - used to address practices not related to personal injury.

Illustrations are for reference only, as actual product may vary.

Aircel
High Inlet Temperature Refrigerated Air Dryer
Models DHT-20, 40, 50, 75, 100, and 125



This manual is property of the owner. Leave with the unit when set-up and start-up are complete. Aircel LLC. reserves the right to change design and specifications without prior notice.

WARNING!

General Safety Procedures

- Improper installation, operation, service or maintenance may contribute to conditions in the work area or facility that could result in personal injury and product or property damage. Check that all equipment is properly selected and sized for the intended use.
- Consult and comply with national and local codes relating to fire or explosion and all other appropriate codes when determining the location and operation of this equipment.
- Safe and efficient operation of the unit depends on proper installation and service.
- Authorities with jurisdiction should be consulted before installing to verify local codes and installation procedures. In the absence of such codes, install unit according to the National Electric Code, NFPA No. 70-latest edition.
- A qualified installation and service agent must complete installation and service of this equipment.
- DO NOT weld on / to pressure vessel or modify it in any way.
- DO NOT remove, modify, or adjust protective or safety devices.
- Lock out power supply and depressurize system before performing maintenance or service work.
- DO NOT operate the equipment with the control panel door open.

  Notice: For optimum performance, use only original equipment replacement parts.

Notice: For information and notes specific to a custom designed and built dryer, reference the drawing package provided with the unit.

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This manual contains specific precautionary statements relative to worker safety. Read thoroughly and comply as directed. Discuss the use and application of this equipment with a representative listed on the manual back cover. Instruct all personnel on safe use and maintenance procedures. Understand and obey the following signal words used in this manual.

- **DANGER!** - indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING!** - indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION!** - indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
- **Notice:** - used to address practices not related to personal injury.

Data Sheet

Model Number _____ Serial Number _____

Date of Manufacture _____

Ship Date _____ Installation Date _____

Customer Name _____

Address _____

_____

Accessories _____

Other _____

Refrigerated Dryer Serial Plate Label

For Mfg Personnel: Affix Label Here if Data Sheet on pg. 3 was not completed.

Refrigerant Safety Precautions

CAUTION!

Inhalation, Skin, & Eye Irritant

- Use proper safety and protective equipment, including chemical safety goggles or face shield and impervious gloves when handling refrigerants.
- Exercise care to ensure that liquid refrigerant does not come in contact with your skin or eyes.
- DO NOT SMOKE.
- Ventilation in work area must be adequate to keep the concentration of refrigerant below 1,000 ppm.
- System must be free of all refrigerant before any welding or brazing can be performed and must be done in a well ventilated area.
- Decomposition of refrigerants is hazardous! This material can be decomposed by high temperatures caused by an open flame. Hydrofluoric acid and possibly carbonyl fluoride can form in a liquid or gaseous state. Avoid exposure to these toxic fumes and irritating materials.
- Leave the work area immediately if you experience any of the following: smell something unusual, feel light-headed, experience shortness of breath, feel a tingling sensation in your fingers or toes, suddenly feel warm or a rapid heartbeat.

Refrigerant First Aid Recommendations

Inhalation

If high concentrations are inhaled, immediately remove individual from affected area to an area with a fresh air supply. Keep individual calm. If not breathing, give artificial respiration or if having difficulty breathing, give oxygen and call for emergency services.

Skin Contact

In case of contact with the skin, immediately flush skin with clean water for at least 15 minutes. Treat for frostbite if necessary by gently warming affected areas and call for emergency services. Remove any contaminated clothing or shoes.

Eye Contact

In case of contact with the eyes, immediately flush eye(s) with clean water for at least 15 minutes and call for emergency services.

Design Parameters

Type of dryer: Refrigerated

Power supply: 115, 230 Volt / single phase / 60Hz

Refrigerant type: R-134A

Chemical Composition: HFC

Parameter Description	Optimum	Maximum	Minimum
Air Pressure (PSIG)	150-175	200	80
Air Inlet Temperature (°F)	100-180	200	40
Ambient Temperature (°F)	75	100	32
Suction Gauge Reading (psig)	28-40	60	28
Discharge Gauge Reading (psig)	160-250	350	80
Evaporator Temperature (°F)	38-42	60	33

Description

System

A broad range of non-cycling refrigerated compressed air dryers from 10 to 10,000 scfm is offered. The High Inlet Temperature Refrigerated Air Dryer series covers a flow range from 20 to 125 scfm providing reliable, constant dew point performance in all flow conditions. Through optimization of critical dryer components – heat exchanger, separator, and condensate removal – the system ensures the highest performance at full- and partial-load conditions. R-134a refrigerant is used in all refrigerated compressed air dryers as standard. R-134a is the industry's preferred choice because of its 0.0 ozone depletion factor and global warming potential. R-134a is a one-blend refrigerant providing consistent performance (no temperature glide) and easy service (no mixture of different refrigerants).

Hot saturated air enters the air-to-air heat exchanger of the High Inlet Temperature Refrigerated Air Dryer and is precooled by the outgoing dry air. Precooling saves energy by reducing the heat load on the dryer's compressor. The cool saturated air enters the air-to-refrigerant heat exchanger where air temperature is lowered to the 48 to 50°F range. This dramatic temperature drop condenses water and oil.

The mixture of cold air and condensation then flows into the two-stage separator filter where liquids and contaminants are removed by centrifugal action, directional flow change, and velocity reduction. Once bulk liquids have been removed, the compressed air goes through a stainless steel mist eliminating filter that coalesces oil aerosols and oil vapors within the 50-micron range, and then separates and removes them. At this point, the compressed air is dry and virtually oil-free.

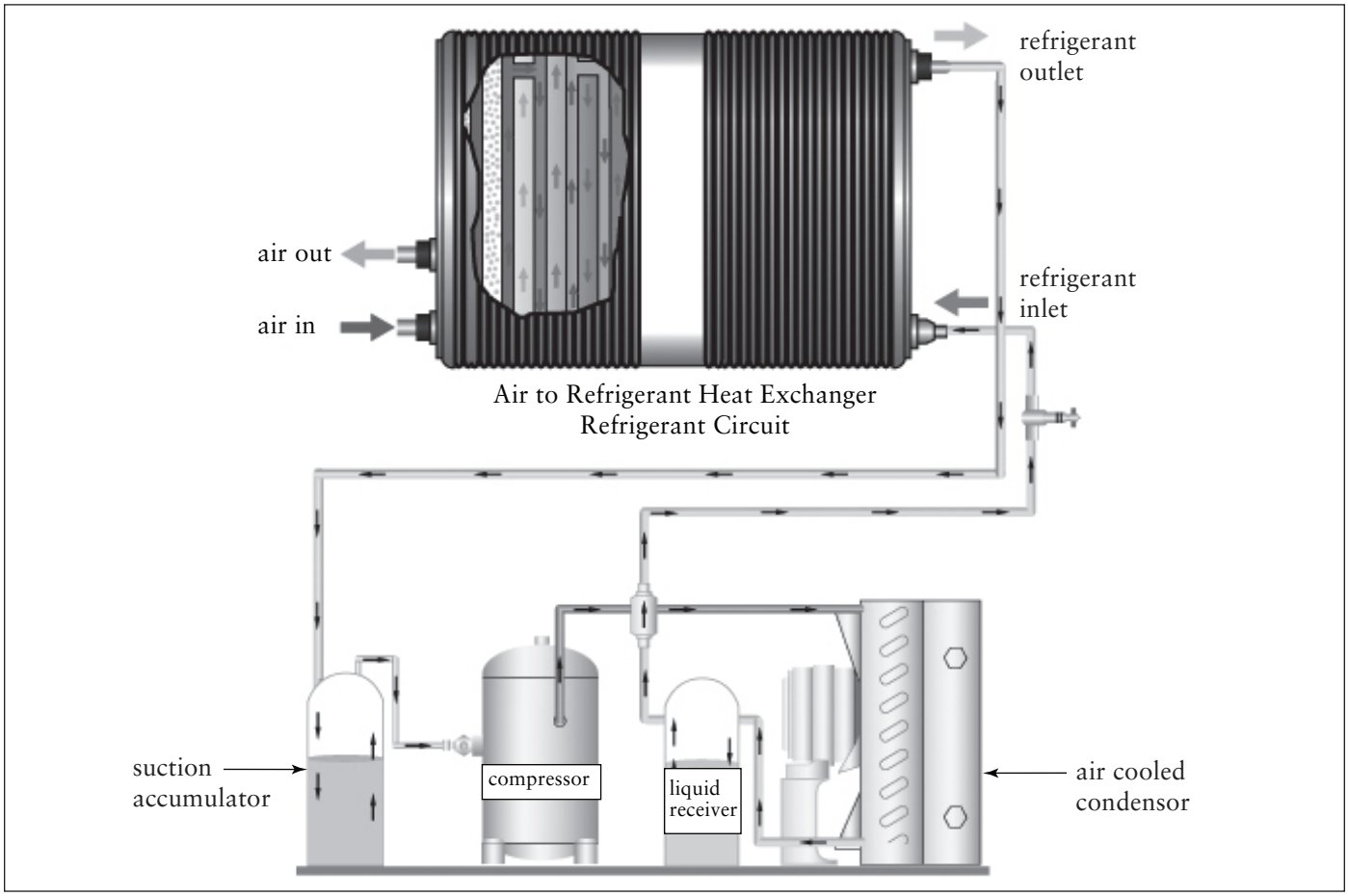
Cold, dry air exits through the precooler heat exchanger and is reheated by incoming hot air. Reheating restores energy and also prevents condensation from forming on the outside of air distribution piping. In the refrigeration unit, the compressor pumps hot, high-pressure gaseous refrigerant to the condenser where it is cooled and liquefied by ambient air. From the condenser, liquid refrigerant first flows through the receiver, then through a filter/dryer, and finally through the expansion valve where pressure and temperature are reduced. This reduction in pressure causes the liquid refrigerant to boil until it reaches the saturation temperature that corresponds to its pressure. As the low-pressure refrigerant passes through the evaporator, heat flows from the compressed air to the refrigerant, causing the boiling to continue until all refrigerant is vaporized. Refrigerant gas is returned to the compressor and the cycle is repeated. A hot gas by-pass valve is used to control temperature in the evaporator.

Refrigeration Circuit

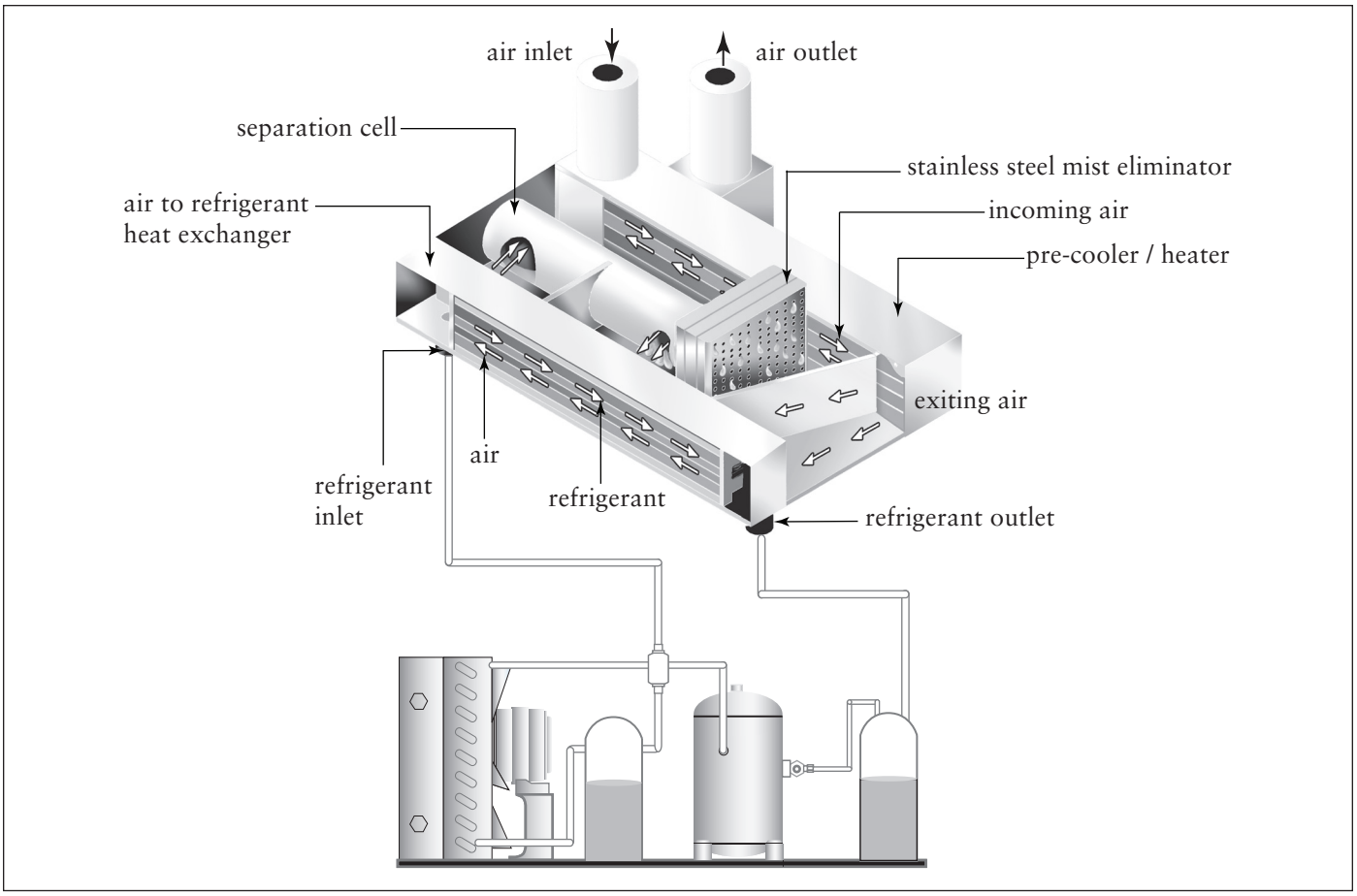
Refrigerant is cycled through a closed loop system commonly known as high pressure and low pressure. Refrigerant is compressed by the compressor to a gas with high temperature and high pressure, which then travels to the condenser (air/water cooled) to drop the temperature and change from gas to liquid. Liquid travels through to the evaporator (refrigerant-to-air part of the heat exchanger) and back to the compressor suction side and the process repeats itself. A thermal expansion hot gas by-pass valve is used on the non-cycling dryers from the high side to low side as a freeze protector in low load conditions (125 scfm).

Compressed Air Circuit

The compressed air dryer circuit uses a patented air-to-air heat exchanger, which acts as a precooler/ reheater (40 scfm rated model and higher). Hot, saturated, compressed air first enters the air-to-air heat exchanger, where it is pre-cooled by outgoing air from the air-to-refrigerant heat exchanger. This energy saving heat exchanger provides several advantages, such as a reduction of the heat load imposed on the refrigerant compressor and condenser, providing more energy to the outlet air, and preventing condensation of moisture on the outside of the plant distribution air line piping. From the air-to-air heat exchanger, air will enter into the evaporator further reducing its temperature to a desired pressure dew point. As the air is cooled, moisture will be condensed, where it is then separated and discharged through the condensate drain. The cooled air then reenters the air-to-air heat exchanger, in a direction opposite to the flow of the warm, saturated incoming air. This counter flow action assures high temperature differential throughout the heat exchanger, resulting in a more effective heat transfer.



Typical Schematic Flow Diagram (20 scfm rated models)



Typical Schematic Flow Diagram (40 - 125 scfm rated models)

Purpose and Intended Use

High inlet temperature refrigerated air dryers are designed for the purpose of removing moisture from the compressed air by using mechanical refrigeration and providing dew points as low as (48° F- 50° F). These dryers are used to protect industrial compressed air systems, machinery, and tools. They are designed to deliver the required dew point at specified inlet air temperature, inlet air pressure, inlet flow and ambient temperature conditions. To ensure maximum performance and safe operation of this dryer, everyone associated with its installation, operation, and maintenance must read and carefully follow the instructions of this manual.

CAUTION!

- Misuse or modification of this equipment may result in personal injury.
- Do not misuse or modify.

Inspection on Arrival

All high inlet temperature series dryers are tested and operated before shipment. However, shipping vibration may cause damage such as loosening of certain parts. To ensure smooth installation, it is recommended that immediately upon receipt of the unit, the system is checked for the following:

1. Inspect unit on delivery.
2. Report any damage to the delivery carrier.
3. Request a written inspection report from the Claims Inspector to substantiate the claim.
4. File claims with the delivery carrier.
5. Compare unit received with description of product ordered. Check the data label and make sure that it is the correct Model that you had ordered. Note the equipment Capacity and Power Supply requirements and ensure that they are in accordance with your specifications. The rated conditions of the dryer are indicated on the serial plate label. If there is any discrepancy, contact your representative listed on the manual back cover.
6. Vibration during shipping can loosen the connections. So inspect all pipe and tubing and make sure they are all tightened and secured.
7. Observe pressure of refrigerant analyzer gauge (suction) to determine if refrigerant has leaked out during transit. If the gauge reading does not match that mentioned on the serial plate label, immediately contact Technical Support listed on the manual back cover.
8. Report incomplete shipments to the delivery carrier and your service representative.

Lifting Information

1. Use all lifting points provided. Special care must be used when lifting the dryer to prevent tip-over.
2. Use clevis connectors, not hooks, on lifting slings.
3. Only lift unit under support frame/base by using the fork lift openings provided. Do not lift by piping.
4. Check the approximate weight provided on the specification control drawing to ensure adequate lift truck capacity.
5. Allow only qualified operators to lift the equipment.
6. Refer to applicable OSHA regulations and local codes when using cranes, forklifts, and other lifting equipment.

WARNING!

- Failure to lift the unit correctly can result in severe personal injury or property damage.
- Use appropriate lifting equipment and adopt all safety precautions needed for moving and handling the equipment.
- A hand cart, forklift or crane is recommended for unloading and installation.
- Lift unit by lifting lugs and frame only. Do not lift by piping.

Installation Codes and Procedures

WARNING!

- Follow proper lock out/tag out procedures before performing service or maintenance work.
- Electrical installation must be performed by a qualified electrician and comply with all applicable national and local codes.

1. Safe and efficient operation of the unit depends on proper installation.
2. Authorities with jurisdiction should be consulted before installing to verify local codes and installation procedures. In the absence of such codes, install unit according to the National Electric Code and NFPA No. 70-latest edition.
3. A qualified installation and service agent versed in all regulatory codes must complete installation of this unit.

CAUTION!

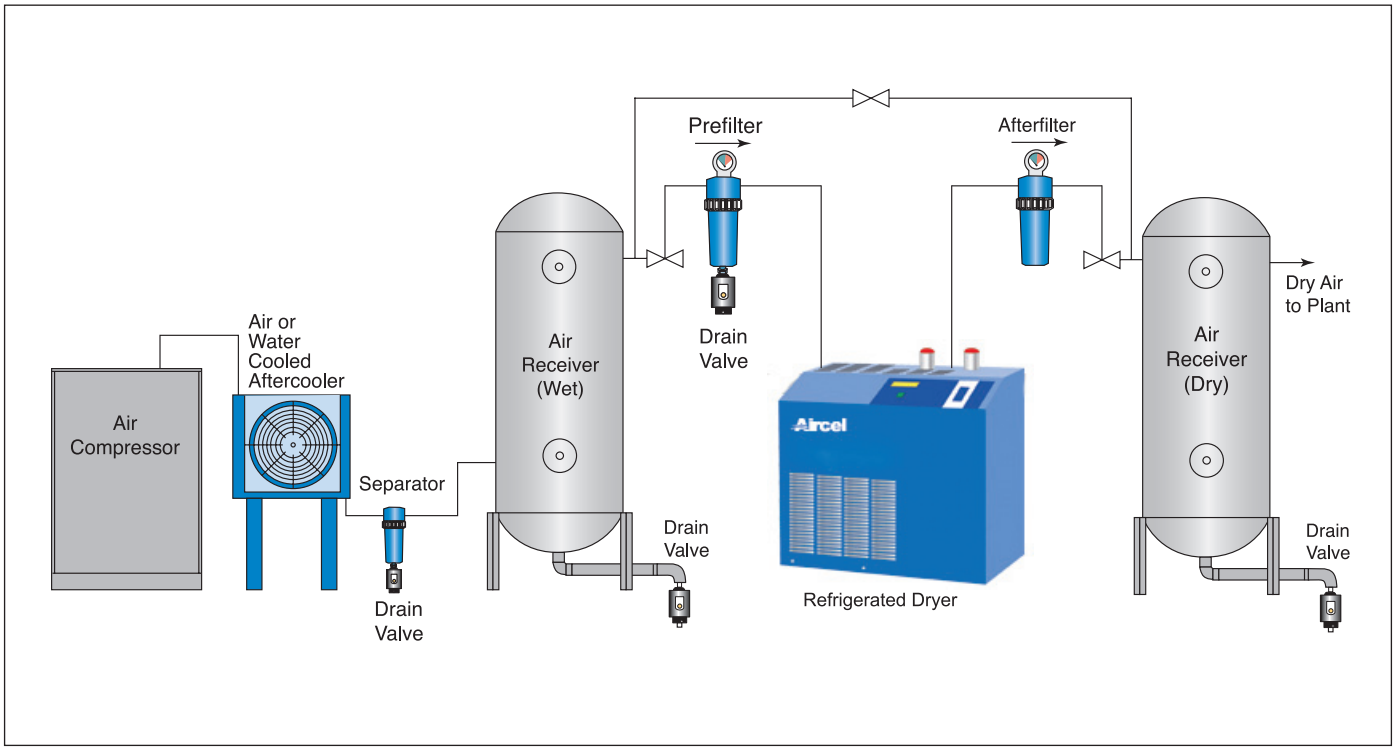
- A copy of the Operation Manual must be made available to all personnel involved with the installation, operation and maintenance of the equipment, to avoid injury to personnel or property damage.
- Appropriate tools must be used for all installation and maintenance work, to avoid injury to personnel or property damage.

Installation

1. Locate unit on a level foundation. Dryer should be mounted on a suitably structured flat and level floor or base that is free from vibration.
2. Install unit to provide adequate clearance for maintenance services. Dryer and accompanying filters (optional) should be installed with at least 2 to 5 feet clearance from the adjoining walls to provide easy access for routine maintenance and adequate air flow across the condensing coil.
3. The frame or cabinet must be securely bolted to the foundation to prevent movement resulting from earth tremors and induced piping vibration.
4. Install unit using the correct pipe size and pressure rating. See Rating and Specification information section. Connect the inlet of the dryer to the moist gas from the compressor/ receiver/inlet filter. Install the Inlet piping and the inlet shutoff valve. Install the outlet piping and the outlet shutoff valve (a union with a valve by-pass can be installed at the inlet and outlet valves to accommodate isolation of the dryer for maintenance). Compressed air piping has to be at least the same size as that of the inlet and outlet connections of the dryer. Larger pipe sizes can be used with appropriately rated reducers.

   Operation at elevated pressure or temperature may cause damage to the dryer or serious injury to personnel. Each dryer is checked at the factory for proper operation at the conditions noted on the serial plate label.
5. Provide adequate power supply. See Rating and Specification information section. Make all electrical connections to the dryer as shown on the wiring diagram. Special care must be taken in connecting the proper voltage as indicated on the specification sheet and wiring schematic. It is mandatory that the dryer be grounded. Use of your plant's frame as a ground may cause problems with the controls. A fused disconnect is not supplied with this equipment; therefore, one must be supplied by customer. All electrical fuses, breakers, etc. should be sized by a qualified electrician and comply with all applicable national and local codes. Our company is not liable for any code violations, component damage, downtime or consequential damage related to customer supplied electrical components and connections.
6. The ambient temperature should be between 40 °F and 100 °F. Low temperature could affect the dryer process and result in high outlet dew point. In conditions where the ambient drops below freezing, it is recommended that a heat trace be used for the equipment. This will ensure trouble-free operation during the winter months (the dew point of the outlet air will be consistent).
7. Do not place the system in service until the above steps have been completed and that all ratings and specifications have been verified to match the requirements in this manual.
8. If there are any changes in the operating conditions of the system from those listed in Rating and Specification section, contact Technical Support for advice on necessary adjustments.

Typical Installation



Typical Installation

Preliminary Start-Up Checklist

Notice: For all models, wait at least 6 hours after transporting or moving of dryer system before starting the dryers. Turn the main power switch to the dryer on, but do not turn the dryer on/off switch to the on position until 6 hours have passed. The power indicating light will be on.

1. Check that the inlet and outlet connections are the correct size and pressure rating, and tightened securely.
2. Check that the correct power supply is connected to the high inlet temperature series refrigerated air dryer system with an adequate disconnect switch.
3. Check that all compressed air line service valves are open and that compressed air is available to be supplied to the high inlet temperature series refrigerated air dryer system.
4. Check that all liquid drain service valves are open. This is to ensure that any residual bulk condensate that may have accumulated in the compressed air lines is discharged immediately upon start up. These drains must be closed once system is brought on line for use. The drain valve on the refrigerated air dryer can be opened by pushing the test button located on the front control panel.
5. With the customer-supplied compressed air to the system, OPEN the inlet valve slowly to gradually pressurize the system. Do not open valve too quickly. Opening valve and suddenly pressurizing the system can cause damage to the dryer heat exchanger and other components.
6. Check the complete air system piping connections and dryer system connections for leaks at this time. Repair and retest all leaks.
7. Verify that all instrumentation (pressure gauge/s) and drain air tubing fittings are tight.
8. Ensure that the air system has come up to full pressure and has filled the high inlet temperature series refrigerated air dryer with compressed air. Before opening the outlet valve on the system and after the dryer has been started under no load, let the dryer run for at least fifteen (15) minutes to allow stabilization of the system. Verify the following:

   a. The dryer is designed to run continually and should not be cycling on and off with the air compressor. The non-cycling operation of the dryer is controlled by an automatic expansion valve or a thermostatic expansion valve / hot gas by-pass valve. The valves will open and close automatically depending on the amount of heat load to the evaporator, thus maintaining the desired pressure dew point.

   b. Check the inlet compressed air temperature and pressure to the dryer and verify that it meets the specified requirements.

   c. Fan rotation, for dryers with an air-cooled condenser, rotation should be in accordance with the fan rotation shown on the details located on top and back of the condenser. Cooling air is drawn through the condenser coils. If the motor rotation is not correct, turn off the power switch and put the main power supply disconnect in the “off” position; lock and tag; check the wiring; correct the wire lead locations; recheck for correct rotation (3 phase unit only).

   d. The refrigeration gauge readings should be as follows:

      - Refrigerant suction pressure R-134a = 28-40 psig
      - Refrigerant discharge pressure R-134a = 160-250 psig

   Notice: The above discharge pressures depend upon ambient temperature and can vary slightly according to temperature fluctuations.

9. After all of the preliminary start up checklist

has been completed, the compressed air outlet valve on the high inlet temperature refrigerated air dryer system can now be slowly opened to supply clean dry compressed air to the facility.

10. After start-up and approximately one month of service, check that all piping and fittings are tight and free of leaks.

    Notices:

    - Models with the hot gas by-pass valves and expansion valves are preset at the factory for the desired dew point. Do not adjust without consulting with the factory.
    - The dryers are fully automatic and do not require any auxiliary controls.

Automatic Drain Valve Adjustments

The automatic drain valve supplied is standard on the separator and should open regularly and discharge any accumulated water into the drain line. The period between openings varies with the dryer and operating conditions (electronic type). To minimize air losses, the timer should be adjusted to open the drain solenoid just long enough to discharge the accumulated condensate. Set the timer so that only air discharges at the end of the open period. Recommended initial settings are (7) seconds drain opening (on time) and a (7) minute close time (off time). If air discharges far more than (2) seconds from the separator discharge, set the timer for a longer cycle time. If liquid discharges as the solenoid is closing, set the timer for a shorter cycle or a longer open time.

Operating Procedure

After the initial startup, the dryer operation is completely automatic. To understand the details of the operation, use the flow diagram on pages 7-8 and the timing sequence of the dryer.

Air Cooled Condenser Requirements

Cooling air must be drawn from a clean source to reduce dust and dirt accumulation on the condenser coils. Air temperature should not exceed 100°F (38°C).

Model by SCFM Rating	Refrigeration Hp	Cooling air flow (cfm)
20	1/3	350
40	1/2	500
50	1/2	500
75	3/4	900
100	3/4	900
125	1	1125

Shut-Down Procedures

WARNING!

- To avoid possible hazard or injury, the operator should be fully familiar with the high inlet temperature series refrigerated air dryer system and its operation.
- When the system is shutdown and power removed, lock out power supply and depressurize system before performing maintenance or service work to avoid injury to personnel or property damage.

Shut-Down Emergency

The high inlet temperature series refrigerated air dryer system can be shut down under any conditions and at any time by turning the unit off at the dryer or at the main disconnect switch. Once power is removed from the dryer system, the dryer must be isolated from the compressed air stream to avoid a refrigeration circuit over pressure situation.

Short-Term Shut-Down (over night or weekends)

The high inlet temperature series refrigerated air dryer system can be shut down at any time by turning the unit off at the dryer by using the on/off switch or at the main disconnect switch.

Service Information

To reach a field service technician or for technical support, please call the number listed on the manual back cover.

Maintenance

Refrigerated air dryers require very little maintenance for satisfactory operation. Good performance can be expected if the following routine maintenance steps are taken.

WARNING!

- Before any service or maintenance work is performed on the high inlet temperature series refrigerated air dryer system, disconnect power supply and lock out power supply and depressurize system before performing maintenance or service work.
- Follow proper lock out/tag out procedures before performing service or maintenance work.
- Prior to performing any maintenance on the dryer, all personnel are strongly advised to familiarize themselves with the equipment by reading the entire contents of this operation manual. All safety procedures should be followed prior to performing any maintenance activity on the dryer.

Daily

With the dryer on-line:

- Verify the operating pressure, temperature, and flow rate are correct and conform to those listed in the Rating and Specification Information section. Adjust system if required.
- Always check refrigerant gauges to insure refrigeration system is working properly.
- Check condensate drain separator for proper condensate discharge. If no discharge is evident then depressurize the unit, dismantle and clean separator and/or drain line. Proper drain trap maintenance is the owner's responsibility. It is not covered by warranty.
- Make certain airflow is directed through dryer only. Observe by-pass valves proper positions.

Weekly

- Repeat all daily inspections and record data in Maintenance log.
- Clean the condenser coils of accumulated dust and dirt with a soft brush and/or with air pressure from a compressed air nozzle (maximum 100 psig).
- Check the gauge readings for good system operation.
- Check oil removal filter (coalescer) indicator (if applicable); if it is red, replace the filter.

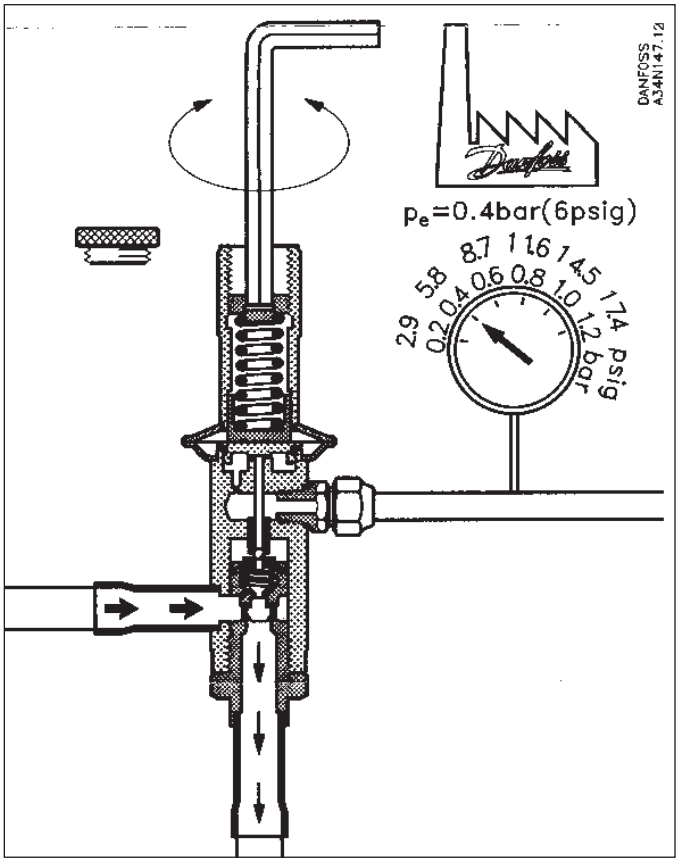
Filter Element Replacement

1. Depressurize the air system to release the compressed air from the air dryer.
   Notice: Shutting down the air compressor will not depressurize the air dryer unit. Close air line valves before and after dryer and then depressurize unit. Depressurize dryer by pushing the test button on the dryer system drain until there is no more pressure in the dryer system.
2. Remove the filter bowl by turning the bowl 1/4 turn counter clockwise, be sure the O-ring is in place on the top half of the oil filter housing and that the O-ring seats properly. Air leaks may occur if the O-ring is not secured (important).
3. The same procedure applies when removing the filter separator for changing the element (if applicable).

Hot Gas By-Pass Adjustment

Check the refrigerant suction pressure gauge for operation, if it requires adjustments perform the following steps:

1. Do not turn off the dryer. Adjust only when no air is passing through dryer.
2. Open the top cover to reach the valve.
3. If the refrigerant suction pressure is below 30 psig (R-134a), turn the adjustment bolt clockwise (1/8 turn intervals) and allow a few minutes for refrigerant to stabilize.
4. If suction pressure is above 45 psig (R-134a), turn the adjusting bolt counter-clockwise.
5. Let the dryer operate for a few minutes and read the suction pressure gauge. Continue to adjust the valve until the pressure reads between 30-40 psig (R-134a).



Hot Gas By-pass adjustment

Troubleshooting

WARNING!

- Before any service or maintenance work is performed on the high inlet temperature series refrigerated air dryer system, disconnect power supply and lock out power supply and depressurize system before performing maintenance or service work.
- Follow proper lock out/tag out procedures before performing service or maintenance work.
- Prior to performing any maintenance on the dryer, all personnel are strongly advised to familiarize themselves with the equipment by reading the entire contents of this operation manual. All safety procedures should be followed prior to performing any maintenance activity on the dryer.

If there is a problem with the high inlet temperature series refrigerated air dryer or contamination downstream is present, the problem may be identified from one or more of the following sources:

- Electrical
- Refrigeration
- Condensate removal (drains)
- Other

Electrical

- Make certain that the dryer is connected to proper power supply in accordance with electrical diagram provided.
- Check electrical breaker/fuse disconnect to determine if there is electrical power to the unit.
- A quick check should determine if the power switch is turned on and the unit is running.
- After determining that the power is supplied to the unit, go to the next step.

WARNING!

- Follow proper lock out/tag out procedures before performing service or maintenance work.
- Electrical installation must be performed by a qualified electrician and comply with all applicable national and local codes.

Refrigeration

Notice: Always observe refrigerant analyzer gauge(s) to determine if and how refrigeration circuit is operating.

High inlet temperature series refrigerated air dryers with R-134a refrigerant should read 28-40 psig refrigerant suction pressures while unit is running with low or no load. If the refrigerant gauge(s) reads more or less than the above specified pressures troubleshoot the following:

1. High refrigerant readings generally indicate:
   - Dirty condenser - Clean immediately!
   - Dryer not turned on during air usage.
   - Overloading - Airflow more than dryer designed for.
   - If high ambient temperature - Provide adequate ventilation for proper cooling.
   - Condenser fan(s) not running - Call Technical Service.
   - Refrigerant control too high - Adjust hot

gas by-pass valve (or constant expansion valve) to lower refrigerant pressure to required settings.

2. Low refrigerant readings generally indicate:
   - Low ambient temperature - Provide ambient temperatures above 15°F.
   - Refrigerant control setting too low - Adjust hot gas by-pass valve (or constant expansion valve) to raise refrigerant pressure to required settings.
   - Loss of refrigerant - Call Technical Service or a qualified refrigeration service.

Condensate Removal

The high inlet temperature refrigerated air dryer uses a refrigeration circuit to cool the compressed air thus condensing the moisture. The moisture is separated from the dry air and purged out through an automatic drain.

1. Condensate downstream of dryer:
   - If the unit is equipped with automatic drain override switch, push manual override button to test drain flow.
   - Ensure automatic electronic timer (if applicable) is functioning properly.
   - Ensure moisture separator (and coalescer) drain lines are free from blockage.
   - If the unit is equipped with y-strainer, disassemble and clean.
   - If oil is downstream from the dryer:
     - Oil coalescer element is saturated.
     - Dryer not turned on during air usage.

WARNING!

Before any service or maintenance work is performed on the high inlet temperature series refrigerated air dryer system, disconnect power supply and lock out power supply and depressurize system before performing maintenance or service work.

Other

Sometimes a water or oil problem downstream from the dryer can be identified by an inadvertent action or inaction by the operator.

- Dryer not turned on before air usage.
- By-pass valves in wrong position.
- Air usage exceeding dryer capacity.
- Oil coalescer element not changed as needed.
- Automatic drains not maintained.

Troubleshooting Table

Problem	Probable Cause	Remedy
Water downstream of dryer system or no discharge from separator/ filter.	Failed or short circuited timer on drain.	Replace timer drain.
	Failed drain solenoid.	Replace timer drain.
	Bulk liquid entering the dryer from upstream.	Check drains on after cooler or air compressor.
	Inlet compressed air temperature to dryer too high for proper cooling of compressed air.	Check inlet air temperature and adjust to meet specifications of dryer system.
	Inlet compressed air CFM flow rate too high for dryer specifications.	Check in inlet air cfm flow rate and adjust to meet specifications of dryer system.
	Leak in the air to air side of the heat exchanger.	Replace heat exchanger.
Water downstream and dryer system not working properly or not working.	Refrigeration compressor stopped due to plugged or dirty condenser coil.	Clean condensing coil and ensure adequate ventilation of unit.
	Refrigeration compressor short cycles and cannot maintain suction pressure.	Locate leak in refrigeration circuit, repair and recharge according to specifications.
	Low refrigerant.	Check for leak in refrigeration circuit, repair and recharge according to specifications.
	Low refrigerant, possible leak in air to refrigerant side of heat exchanger.	Repair or replace heat exchanger and recharge according to specifications.
	Refrigeration compressor is overheated.	Turn off dryer and wait 20 - 40 minutes, restart dryer.
	Refrigeration compressor has burned out or windings have gone to ground.	Replace compressor, check for leak in refrigeration circuit, repair and recharge according to specifications.

Problem	Probable Cause	Remedy
Water downstream and dryer system not working properly or not working (Cont).	Refrigeration compressor short cycles and cannot maintain suction pressure, dryer undersized.	Check airflow (cfm) and dryer capacity. Reduce airflow through dryer or replace with a larger rated cfm dryer.
	Shorted fan motor winding.	Check fan motor with ohmmeter and refer to motor specifications for correct value and check wiring schematic to ensure proper wiring of fan motor. Replace motor if required.
	Fan motor overload cutting out or unit short cycling.	Check circuitry against electrical schematic (wiring diagram). Check for high refrigerant pressure or for high ambient temperature.
	Defective overload protectors (fuses or breakers).	Check overload protectors and replace if necessary.
	Low voltage or 3-phase imbalance.	Check incoming power supply, voltage must be within 8-12% of rating on data plate.
	Low water flow or pressure to water-cooled condenser.	Check water flow and/or pressure and adjust according to specifications.
	Defective fan control cycling switch.	Replace fan control cycling switch.
Low air pressure downstream or high pressure drop across the dryer system.	Optional pre-filter element dirty or plugged.	Replace filter element.
	Suction pressure below set point which causes freezing in the dryer heat exchanger.	If expansion valve is out of adjustment, contact an authorized service technician.
Notice: To confirm freeze-up, shut system off for 20 min and allow to thaw. Air pressure in line should come back to normal pressure.	Suction pressure below set point which causes freezing in the dryer heat exchanger.	Refrigeration circuit low on refrigerant, locate leak in refrigeration circuit, repair and recharge according to specifications.
	Incorrect sizing or restriction in compressed air line piping.	Check compressed air piping for restrictions. Check piping size to verify if it has the capacity to handle the rated scfm at present working pressure of compressed air system.

Troubleshooting Table, continued

Problem	Probable Cause	Remedy
Low air pressure downstream due to continuous air flow through the moisture drain line.	Failed or short circuited timer on drain.	Replace timer drain.
	Failed drain solenoid.	Replace timer drain.
	Solenoid valve stuck open.	Reference the “timer drain stuck open” troubleshooting section below.
Noise or vibration coming from refrigerated air dryer system.	System dropped during shipping causing compressor mounting to loosen.	Check all mounting bolts on compressor and tighten.
	Cabinet panels or support beams loosened during shipping.	Check all screws and bolts on dryer system and tighten.
	Loose mounting bolts, bent fan blade or worn bearings on condenser fan motor.	Tighten bolts, straighten or replace fan blade or replace motor.
	Noise coming from refrigeration compressor due to liquid refrigerant in compressor - caused by shipping or moving of dryer.	Let dryer system sit for six hours to allow refrigerant to settle out of compressor and to allow crankcase heater to warm compressor.
Timer drain stuck open.	Failed or dirty timer drain.	If power is off and the air stops leaking, replace the timer drain. If power is off and air continues leaking, clean the timer drain.

Problem	Probable Cause	Remedy
High Refrigeration Circuit Head Pressure (compressor is overloaded and gauge is reading out of recommended pressure range).	Refrigeration condenser coil fouled or dirty or air flow blocked.	Clean / blow off condensing coil of dirt or debris from the inside out. Clear area in front of condensing coil of any items blocking airflow to coil.
	Condenser fan motor not working properly or faulty.	Check fan motor for proper voltage and amp draw, repair or replace fan motor.
	Defective fan control switch.	Repair switch or replace.
	Ambient temperature too high at refrigeration dryer location.	Cool ambient temperature around location of refrigeration dryer down to a maximum of 100° F or relocate dryer to a different area with lower ambient temperature.
	Compressed air temperature entering the refrigeration dryer is too high.	Check compressed air inlet temperature to ensure it is within the operating parameters listed in the Design Parameter section. Check air compressor after cooler for malfunction.
	Faulty heat exchanger, compressed air leaking into refrigeration circuit.	Repair or replace evaporator or heat exchanger and recharge with refrigerant.
Low Refrigeration Circuit Head Pressure (gauge is reading out of recommended pressure range).	Ambient temperature too low at refrigeration dryer location.	Increase ambient temperature at refrigeration dryer location or relocate dryer.
	Refrigeration dryer circuit low on refrigerant.	Refrigeration circuit low on refrigerant, locate leak in refrigeration circuit, repair and recharge according to specifications.
	Refrigeration compressor not working properly or faulty.	Check refrigeration compressor for proper voltage and amp draw, repair or replace refrigeration compressor.

	Compressed air temperature to refrigeration dryer too low.	The inlet compressed air temperature must be higher than 40° F. If compressed air temperature is lower than 40° F, turn refrigerated air dryer off. Air may pass through the dryer under this condition, once the compressed air temperature has increased to 44° F the dryer must be turned back on to avoid a high refrigerant pressure situation or isolate the dryer from the compressed air stream.
Problem	**Probable Cause**	**Remedy**
High refrigerant suction pressure, suction gauge reading out of range and water downstream of refrigeration dryer.	Refrigeration circuit hot gas bypass valve out of adjustment or defective.	Contact an authorized service technician.
	Refrigeration expansion valve or TXV adjustment fitting out of adjustment.	Contact an authorized service technician.
Low refrigerant suction pressure, suction gauge reading out of range and/ or refrigeration compressor covered with ice.	Refrigeration circuit hot gas bypass valve out of adjustment or defective.	Contact an authorized service technician.
	Refrigeration expansion valve or TXV adjustment fitting out of adjustment and is not feeding enough refrigerant to the evaporator.	Contact an authorized service technician.
	Excessive pressure drop on the high side of the refrigeration circuit.	Check for a plugged in line filter dryer or receiver on the refrigeration circuit that could be causing these restrictions.
Compressor oil downstream of refrigerated air dryer.	Check optional prefilter condensate drain for failure.	Dismantle prefilter drain and clean or replace.
	Failed or plugged prefilter element.	Check optional prefilter and replace element.
	Air compressor injecting too much oil into the airstream.	Check air compressor for oil leak into the air stream, check air oil separator element for failure.

Appendix

Refrigerant Material Safety Data Sheet

AIR LIQUIDE

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: NON-FLAMMABLE GAS MIXTURE

Containing One of the Following Components in a Nitrogen or Air Balance Gas:
Dichlorodifluoromethane, 0.0005-2.0%; Trichlorofluoromethane, 0.0005-2.0%;
1,1,2-Trichloro-1,1,2-trifluoroethane, 0.0005-2.0%; Tetrafluoroethane, 0.0005-2.0%

SYNONYMS: Not Applicable
CHEMICAL FAMILY NAME: Not Applicable
FORMULA: Not Applicable
Document Number: 50040

Note: The Material Safety Data Sheet is for this gas mixture supplied in cylinders with 33 cubic feet (935 liters) or less gas capacity (DOT - 39 cylinders). This MSDS has been developed for various gas mixtures with the composition of components within the ranges listed in Section 2 (Composition and Information on Ingredients). Refer to the product label for information on the actual composition of the product.

PRODUCT USE:	Calibration of Monitoring and Research Equipment
SUPPLIER/MANUFACTURER'S NAME:	CALGAZ, LLC
ADDRESS:	821 Chesapeake Drive Cambridge, MD 21613
EMERGENCY PHONE:	CHEMTREC: 1-800-424-9300
BUSINESS PHONE:	1-410-228-6400
General MSDS Information	1-713/868-0440
Fax on Demand:	1-800/231-1366

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIHTLV		OSHA-PEL		NIOSH	OTHER
			TWA ppm	STEL ppm	TWA ppm	STEL ppm	IDLH ppm	ppm
Dichlorodifluoromethane (Freon 12)	75-71-8	0-2.0%	1000	NE	1000	NE	15,000	NIOSH REL:TWA = 1000 DFG MAKs:TWA = 1000 PEAK = 2•MAK 15 min., average value,1 hr interval DFG MAK Pregnancy Risk Classification: C Carcinogenicity: TLV-A4
Trichlorofluoromethane (Freon 11)	75-69-4	0-2.0%	NE	1000 (ceiling)	1000	1000 [ceiling] (Vacated 1989 PEL)	2000	NIOSH REL: STEL = 1000 (ceiling) DFG MAKs: TWA = 1000 PEAK = 2•MAK, 15 min., average value, 1 hr interval DFG MAK Pregnancy Risk Classification: C Carcinogenicity: TLV-A4

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIHTLV		OSHA-PEL		NIOSH	OTHER
			TWA ppm	STEL ppm	TWA ppm	STEL ppm	IDLH ppm	ppm
1,1,2-Trichloro-1,1,2-trifluoroethane (Freon 113)	76-13-1	0-2.0%	1000	1250	1000	1250 (Vacated 1989 PEL)	2000	NIOSH RELs:TWA = 1000 STEL = 1250 DFG MAKs:TWA = 500 PEAK = 2•MAK 15 min., average value, 1 hr interval Carcinogenicity: TLV-A4
1,1,1,2-Tetrafluoroethane (HFC-134a)	811-97-2	0-2.0%	NE	NE	NE	NE	NE	DFG MAKs:TWA = 1000 PEAK = 8•MAK 15 min., average value, 1 hr interval DFG MAK Pregnancy Risk Classification: C
Nitrogen or Air	7727-37-9 132259-10-0	Balance	There are no specific exposure limits for Nitrogen. Nitrogen is a simple asphyxiant (SA). The composition of Air is as follows: 79% Nitrogen and 21% Oxygen. These components and their concentrations have been incorporated into this MSDS. There are no specific exposure limits for Oxygen. Oxygen levels should be maintained above 19.5%.					

NE = Not Established. See Section 16 for Definitions of Terms Used.
NOTE (1): ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-1998 format. This gas mixture has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

Refrigerant Material Safety Data Sheet, continued

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This gas mixture is a colorless, odorless gas. Releases of this gas mixture for which Nitrogen is the balance gas may produce oxygen-deficient atmospheres (especially in confined spaces or other poorly-ventilated environments); individuals in such atmospheres may be asphyxiated. Components of this gas mixture (1,1,2-Trichloro-1,1,2-trifluoroethane, Tetrafluoromethane, Trichlorofluoromethane, and Dichlorodifluoromethane) may cause drowsiness and other central nervous system effects in high concentrations; however, due to their low concentration in this gas mixture, this is unlikely to occur. If components of this gas mixture (1,1,2-Trichloro-1,1,2-trifluoroethane, Tetrafluoromethane, Trichlorofluoromethane, and Dichlorodifluoromethane) are exposed to fire, they may decompose yielding toxic products (i.e. hydrogen fluoride, phosgene, hydrogen chloride, carbonyl fluoride).

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant route of over-exposure for this gas mixture is by inhalation.
INHALATION: Due to the small size of an individual cylinder of this gas mixture, no unusual health effects from over-exposure to the product are anticipated under routine circumstances of use. The chief health hazard associated with this gas mixture for which Nitrogen is the balance gas and is released in a small, poorly-ventilated area (i.e. an enclosed or confined space) is the development of an oxygen-deficient environment. Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of over-exposure, death may occur. The effects associated with various levels of oxygen are as follows:

CONCENTRATION OF OXYGEN	OBSERVED EFFECT
12-16% Oxygen:	Breathing and pulse rate increased, muscular coor-dination slightly disturbed.
10-14% Oxygen:	Emotional upset, abnormal fatigue, disturbed respiration.
6-10% Oxygen:	Nausea, vomiting, collapse, or loss of consciousness.
Below 6%:	Convulsive movements, possible respiratory collapse, and death.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Over-exposure to this gas mixture may cause the following health effects:
ACUTE: Due to the small size of the individual cylinder of this gas mixture, no unusual health effects from exposure to the product are anticipated under routine circumstances of use. The most significant hazard associated with this gas mixture when it contains less than 19.5% oxygen is the potential for exposure to oxygen-deficient atmospheres. Symptoms of oxygen deficiency include respiratory difficulty, ringing in ears, headaches, shortness of breath, wheezing, headache, dizziness, indigestion, nausea, unconsciousness, and death. The skin of a victim of over-exposure may have a blue color.
CHRONIC: Chronic exposure to oxygen-deficient atmospheres (below 18% oxygen in air) may effect the heart and nervous system.
TARGET ORGANS: ACUTE: Respiratory system, eyes. CHRONIC: Heart, cardiovascular system, central nervous system, reproductive system.

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH HAZARD	(BLUE)	1
FLAMMABILITY HAZARD	(RED)	0
PHYSICAL HAZARD	(YELLOW)	0

PROTECTIVE EQUIPMENT

EYES	RESPIRATORY	HANDS	BODY
See Section 8			

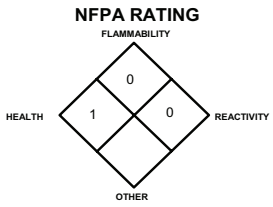
For Routine Industrial Use and Handling Applications

4. FIRST-AID MEASURES

RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO THIS GAS MIXTURE WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. If necessary, Self-Contained Breathing Apparatus must be worn.
No unusual health effects are anticipated after exposure to this gas mixture, due to the small cylinder size. If any adverse symptom develops after over-exposure to this gas mixture, remove victim(s) to fresh air as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation if necessary. Victim(s) who experience any adverse effect after over-exposure to this gas mixture must be taken for medical attention. Rescuers should be taken for medical attention if necessary. Take a copy of the label and the MSDS to physician or other health professional with victim(s).
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Acute or chronic respiratory conditions may be aggravated by over-exposure to the components of this gas mixture.
RECOMMENDATIONS TO PHYSICIANS: Administer oxygen, if necessary; treat symptoms; eliminate exposure. Note: Epinephrine increases the toxicity of Chlorodifluoromethane on the heart.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable.
AUTOIGNITION TEMPERATURE: Not applicable.
FLAMMABLE LIMITS (in air by volume, %):
Lower (LEL): Not applicable.
Upper (UEL): Not applicable.
FIRE EXTINGUISHING MATERIALS: Non-flammable gas mixture. Use extinguishing media appropriate for surrounding fire.
UNUSUAL FIRE AND EXPLOSION HAZARDS: This gas mixture is not flammable; however, containers, when involved in fire, may rupture or burst in the heat of the fire. Additionally, mixtures of this gas for which Air is the balance gas, can support combustion.
Explosion Sensitivity to Mechanical Impact: Not sensitive.
Explosion Sensitivity to Static Discharge: Not sensitive.
SPECIAL FIRE-FIGHTING PROCEDURES: Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. If water is not available for cooling or protection of cylinder exposures, evacuate the area.



6. ACCIDENTAL RELEASE MEASURES

LEAK RESPONSE: Due to the small size and content of the cylinder, an accidental release of this gas mixture presents significantly less risk of an oxygen-deficient environment and other safety hazards than a similar release from a larger cylinder. However, as with any chemical release, extreme caution must be used during emergency response procedures. In the event of a release in which the atmosphere is unknown, and in which other chemicals are potentially involved, evacuate immediate area. Such releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a leak, clear the affected area, protect people, and respond with trained personnel. Allow the gas mixture to dissipate. If necessary, monitor the surrounding area (and the original area of the release) for oxygen. Oxygen levels must be above 19.5% before non-emergency personnel are allowed to re-enter area.
If leaking incidentally from the cylinder, contact your supplier.

7. HANDLING and USE

WORK PRACTICES AND HYGIENE PRACTICES: Be aware of any signs of dizziness or fatigue, especially if work is done in a poorly-ventilated area; exposures to fatal concentrations of this gas mixture could occur without any significant warning symptoms, due to oxygen deficiency. Do not attempt to repair, adjust, or in any other way modify cylinders containing this gas mixture. If there is a malfunction or another type of operational problem, contact nearest distributor immediately.
STORAGE AND HANDLING PRACTICES: Cylinders should be firmly secured to prevent falling or being knocked-over. Cylinders must be protected from the environment, and preferably kept at room temperature (approximately 21°C [70°F]). Cylinders should be stored in dry, well-ventilated areas, away from sources of heat, ignition, and direct sunlight. Protect cylinders against physical damage.
Full and empty cylinders should be segregated. Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. These cylinders are not refillable. **WARNING! Do not refill DOT 39 cylinders. To do so may cause personal injury or property damage.**
SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: WARNING! Compressed gases can present significant safety hazards. During cylinder use, use equipment designed for these specific cylinders. Ensure all lines and equipment are rated for proper service pressure.
PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely. Always use product in areas where adequate ventilation is provided.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: No special ventilation systems or engineering controls are needed under normal circumstances of use. As with all chemicals, use this gas mixture in well-ventilated areas. If this gas mixture is used in a poorly-ventilated area, install automatic monitoring equipment to detect the levels of Phosphine and Oxygen.

RESPIRATORY PROTECTION: No special respiratory protection is required under normal circumstances of use. Maintain Phosphine levels below 50% of the TLV (TLV = 0.3 ppm) and oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection when Phosphine levels exceed 50% of the TLV (TLV = 0.3 ppm), oxygen levels are below 19.5%, or during emergency response to a release of this gas mixture. During an emergency situation, before entering the area, check the concentration of Phosphine and Oxygen. If respiratory protection is required, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent State standards.

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: Wear leather gloves when handling cylinders. Chemically resistant gloves should be worn when using this gas mixture. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: No special protection is needed under normal circumstances of use. If a hazard of injury to the feet exists due to falling objects, rolling objects, where objects may pierce the soles of the feet or where employee's feet may be exposed to electrical hazards, use foot protection, as described in U.S. OSHA 29 CFR 1910.136.

9. PHYSICAL and CHEMICAL PROPERTIES

The following information is for Nitrogen, the main component of this gas mixture.

GAS DENSITY @ 32°F (0ºC) and 1 atm: .072 lbs/ ft^3 (1.153 kg/m^3)
FREEZING/MELTING POINT @ 10 psig: -345.8°F (-210°C)
SPECIFIC GRAVITY (air = 1) @ 70°F (21.1°C): 0.906
SOLUBILITY IN WATER vol/vol @ 32°F (0ºC) and 1 atm: 0.023
EVAPORATION RATE (nBuAc = 1): Not applicable.
VAPOR PRESSURE @ 70°F (21.1°C) (psig): Not applicable.
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.
BOILING POINT: -320.4°F (-195.8°C)
pH: Not applicable.
MOLECULAR WEIGHT: 28.01
EXPANSION RATIO: Not applicable.
SPECIFIC VOLUME (ft^3/lb): 13.8

The following information is for Air, a balance gas:

The following information is for Air, a balance gas:

BOILING POINT: -317.8°F (-194.3°C)
SOLUBILITY IN WATER Vol/Vol at 0ºC (32ºF): 0.0292
SPECIFIC GRAVITY (air = 1) @ 70°F (21.1°C): 1
EVAPORATION RATE (nBuAc = 1): Not applicable.
ODOR THRESHOLD: Not applicable.
VAPOR PRESSURE @ 21.1°c; 70°F (psig): Not applicable.
FREEZING/MELTING POINT (@ 10 psig: -216.2°C (-357.2°F)
MOLECULAR WEIGHT: 28.975
pH: Not applicable.
EXPANSION RATIO: Not applicable.
SPECIFIC VOLUME (ft^3/lb): Not applicable for Air; 13.8 (for Nitrogen)
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

The following information is for the gas mixture:

APPEARANCE AND COLOR: This gas mixture is a colorless, odorless gas.
HOW TO DETECT THIS SUBSTANCE (warning properties): In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation.

10. STABILITY and REACTIVITY

STABILITY: Normally stable in gaseous state.

DECOMPOSITION PRODUCTS: Due to components of this gas mixture (1,1,2-Trichloro-1,1,2-trifluoroethane, Tetrafluoromethane, Trichlorofluoromethane, and Dichlorodifluoromethane), if exposed to fire, this gas mixture may decompose yielding toxic products (i.e. hydrogen fluoride, phosgene, hydrogen chloride, carbonyl fluoride). The other components of this gas mixture do not decompose, per se, but can react with other compounds in the heat of a fire.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Titanium will burn in Nitrogen (a main component of this gas mixture). Lithium reacts slowly with Nitrogen at ambient temperatures. Components of this gas mixture (1,1,2-Trichloro-1,1,2-trifluoroethane, Tetrafluoromethane, Trichlorofluoromethane, and Dichlorodifluoromethane) are incompatible with sodium, potassium, calcium, zinc, and magnesium, powdered aluminum, and alloys of these metals.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible materials. Cylinders exposed to high temperatures or direct flame can rupture or burst.

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following toxicology data are available for the components of this gas mixture:

DICHLORODIFLUOROMETHANE:

LC (Inhalation-rat) > 80 pph/4 hours
LC_{50} (Inhalation-mouse) 3348 gm/m^3/3 hours: Behavioral: sleep, tremor, excitement
LC_{50} (Inhalation-rabbit) 80 pph/30 minutes
LC_{50} (Inhalation-guinea pig) 80 pph/30 minutes
TCLo (Inhalation-Human) 200000 ppm/30 minutes: conjunctive, fibrosing alveolitis, liver changes
TCLo (Inhalation-rat) 4136 mg/m^3/8 hours/6 weeks-intermittent: chronic pulmonary edema; Related to Chronic Data: death
TCLo (Inhalation-rat) 3997 mg/m^3/90 days-continuous: Lungs, Thorax, or Respiration: chronic pulmonary edema; death
TCLo (Inhalation-monkey) 3997 mg/m^3/90 days-continuous: Lungs, Thorax, or Respiration: chronic pulmonary edema
TCLo (Inhalation-rabbit) 3997 mg/m^3/90 days-continuous: Lungs, Thorax, or Respiration: chronic pulmonary edema
TCLo (Inhalation-guinea pig) 3997 mg/m^3/90 days-continuous: Lungs, Thorax, or Respiration: chronic pulmonary edema; Liver: hepatitis (hepatocellular necrosis), diffuse; Related to Chronic Data: death
LD (Oral-rat) > 5600 µg/kg
TDLo (Oral-rat) 2548 mg/kg/26 weeks-intermittent: Behavioral: alteration of classical conditioning; Blood: changes in erythrocyte (RBC) count; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: true cholinesterase

1,1,1,2-TETRAFLUOROETHANE:

LC_{50} (Inhalation-Rat) 1500 gm/m^3/4 hours
LC_{50} (Inhalation-Mouse) 1700 gm/m^3/2 hours
LC (Inhalation-Dog) > 32 pph/1 hour
TCLo (Inhalation-Rat) 50,000 ppm/6 hours/2 years-intermittent: Tumorigenic: neoplastic by RTECS criteria; Endocrine: tumors
TCLo (Inhalation-Rat) 30 pph/6 hours: female 6-15 day(s) after conception: Reproductive: Maternal Effects: other effects; Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus)

TRICHLOROFLUOROMETHANE:

TCLo (Inhalation-Human) 50,000 ppm/30 minutes: Sense Organs and Special Senses (Eye):conjunctive irritation; Lungs, Thorax, or Respiration: fibrosing aleveolitis; Liver: other changes
LD (Oral-Rat) > 352 mg/kg
LD_{50} (Intraperitoneal-Mouse) 1743 mg/kg: Behavioral: convulsions or effect on seizure threshold
LC_{50} (Inhalation-Rat) 13 pph/15 minutes: Behavioral: tremor, convulsions or effect on seizure threshold; Lungs, Thorax, or Respiration: respiratory depression
LC_{50} (Inhalation-Mouse) 10 pph/30 minutes
LC_{50} (Inhalation-Rabbit) 25 pph/30 minutes
LC_{50} (Inhalation-Guinea Pig) 25 pph/30 minutes
TCLo (Inhalation-Rat) 12,000 ppm/4 hours/days-intermittent: Brain and Coverings: other degenerative changes; Lungs, Thorax, or Respiration: chronic pulmonary edema

1,1,2-TRICHLORO-1,1,2-TRIFLUOROETHANE:

TCLo (Inhalation-Human) 4300 mg/m^3/5 Days-intermittent: Brain and Coverings: recordings from specific areas of CNS
TCLo (Inhalation-Human) 178 mg/m^3/10 years-intermittent: Behavioral: headache
Open Irritation Test (Skin-Rabbit) 500 mg: Mild
Standard Draize Test (Skin-Rabbit) 500 mg/24 hours: Mild
LD_{50} (Oral-Rat) 43 gm/kg: Behavioral: somnolence (general depressed activity); Gastrointestinal: other changes; Skin and Appendages: hair
LD_{50} (Intravenous-Mouse) 9 gm/kg: Autonomic Nervous System: other (direct) para-sympathomimetic; Behavioral: altered sleep time (including change in righting reflex); Skin and Appendages: dermatitis, other (after systemic exposure)
LD_{50} (Unreported-Mouse) 40 gm/kg
LDLo (Oral-Rabbit) 17 gm/kg
LC_{50} (Inhalation-Rat) 38,500 ppm/4 hours: Behavioral: general anesthetic, excitement, ataxia

Refrigerant Material Safety Data Sheet, continued

11. TOXICOLOGICAL INFORMATION

1,1,2-TRICHLORO-1,1,2-TRIFLUOROETHANE (continued):

LC_{50} (Inhalation-Mouse) 260 gm/m^3/2 hours: Behavioral: somnolence (general depressed activity), ataxia; Lungs, Thorax, or Respiration: cyanosis

LC_{50} (Inhalation-Rabbit) 59,500 ppm/2 hours: Sense Organs and Special Senses (Eye): effect, not otherwise specified; Behavioral: excitement; Lungs, Thorax, or Respiration: respiratory stimulation

LC_{50} (Inhalation-Guinea Pig) >12 pph/2 hours

LD (Skin-Rabbit) > 11 gm/kg

LDLo (Oral-Guinea Pig) > 10 gm/kg

TCLo (Inhalation-Rat) 20 pph/6 hours/2 years-intermittent: Kidney, Ureter, Bladder: other changes in urine composition; Nutritional and Gross Metabolic: weight loss or decreased weight gain

TCLo (Inhalation-Rat) 2000 ppm/6 hours/2 weeks-intermittent: Liver: other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: hepatic microsomal mixed oxidase (dealkylation, hydroxylation, etc.); Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other transferases

TCLo (Inhalation-Guinea Pig) 70000 mg/m^3/4 hours/16 weeks-intermittent: Brain and Coverings: recordings from specific areas of CNS; Lungs, Thorax, or Respiration: other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: phosphatases

TCLo (Inhalation-Rabbit) 20 ppm: female 8-16 day(s) after conception: Reproductive: Maternal Effects: other effects; Effects on Newborn: physical

TDLo (Oral-Rabbit) 5 gm/kg: female 8 day(s) after conception: Reproductive: Maternal Effects: other effects; Fertility :abortion; Effects on Embryo or Fetus: fetal death

NITROGEN:

There are no specific toxicology data for Nitrogen. Nitrogen is a simple asphyxiant, which acts to displace oxygen in the environment.

SUSPECTED CANCER AGENT: The components of this gas mixture are listed by agencies tracking the carcinogenic potential of chemical compounds, as follows:

DICHLORODIFLUOROMETHANE: ACGIH TLV-A4 (Not Classifiable as to Carcinogenicity in Humans)

TRICHLOROFLUOROMETHANE: ACGIH TLV-A4 (Not Classifiable as to Carcinogenicity in Humans)

1,1,2-TRICHLORO-1,1,2-TRIFLUOROETHANE: ACGIH TLV-A4 (Not Classifiable as to Carcinogenicity in Humans)

The remaining components of this gas mixture are not found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, and IARC; therefore, they are not considered to be, nor suspected to be, cancer-causing agents by these agencies. Nitrous Oxide is listed as ACGIH-A4 (Not Classifiable as a Human Carcinogen).

IRRITANCY OF PRODUCT: Contact with rapidly expanding gases can be irritating to exposed skin and eyes.

SENSITIZATION TO THE PRODUCT: This gas mixture is not known to cause sensitization in humans.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of this gas mixture and its components on the human reproductive system.

Mutagenicity: No mutagenicity effects have been described for the components of this gas mixture.

Embryotoxcity: No embryotoxic effects have been described for the components this gas mixture.

Teratogenicity: No teratogenicity effects have been described for the components of this gas mixture.

Reproductive Toxicity: No reproductive toxicity effects have been described for the components of gas mixture.

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) have not been determined for the components of this gas mixture.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: The gas will be dissipated rapidly in well-ventilated areas. 1,1,2-Trichloro-1,1,2-trifluoroethane, Trichlorofluoromethane, and Dichlorodifluoromethane are chlorofluorocarbon (CFC) compounds. Chlorofluorocarbon compounds have been implicated in the possible depletion of the stratospheric ozone, via a series of complex chemical reactions which occur in the upper atmosphere. Atmospheric ozone is essential in protecting plants and animals from potentially harmful ultraviolet-light exposures. All work practice must be directed at eliminating environmental contamination. The following environmental data are applicable to the components of this gas mixture.

DICHLORODIFLUOROMETHANE: Log Kow = 2.16; Water Solubility = 0.28 g/L 27 25°C.

OXYGEN: Water Solubility = 1 volume Oxygen/32 volumes water at 20°C. Log K_{ow} = -0.65

NITROGEN: Water Solubility = 2.4 volumes Nitrogen/100 volumes water at 0°C. 1.6 volumes Nitrogen/100 volumes water at 20°C.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on the effects of this gas mixture' on plant and animal life.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this gas mixture's effects on aquatic life. The following aquatic toxicity data are available for the components of this gas mixture.

1,1,1,2-TETRAFLUOROETHANE:

EC_{50} (*Dapnia magna*) 48 hours = 980 mg/L

LC_{50} (*Dapnia magna*) 48 hours = 450 mg/L

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Cylinders with undesired residual product may be safely vented outdoors with the proper regulator. For further information, refer to Section 16 (Other Information).

14. TRANSPORTATION INFORMATION

THIS GAS MIXTURE IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

THIS GAS MIXTURE IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Compressed gases, n.o.s. (*Oxygen, Nitrogen)*or the gas component with the next highest concentration next to Nitrogen.

HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)

UN IDENTIFICATION NUMBER: UN 1956

PACKING GROUP: Not applicable.

DOT LABEL(S) REQUIRED: Non-Flammable Gas

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 126

MARINE POLLUTANT: The components of this gas mixture are not classified by the DOT as Marine Pollutants (as defined by 49 CFR 172.101, Appendix B).

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles can present serious safety hazards. If transporting these cylinders in vehicles, ensure these cylinders are not exposed to extremely high temperatures (as may occur in an enclosed vehicle on a hot day). Additionally, the vehicle should be well-ventilated during transportation.

Note: DOT 39 Cylinders ship in a strong outer carton (overpack). Pertinent shipping information goes on the outside of the overpack. DOT 39 Cylinders do not have transportation information on the cylinder itself.

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas is considered as Dangerous Goods, per regulations of Transport Canada.

PROPER SHIPPING NAME: Compressed gases, n.o.s. (*Oxygen, Nitrogen)*or the gas component with the next highest concentration next to Nitrogen.

HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)

UN IDENTIFICATION NUMBER: UN 1046

PACKING GROUP: Not Applicable

HAZARD LABEL: Class 2.2 (Non-Flammable Gas)

SPECIAL PROVISIONS: None

EXPLOSIVE LIMIT AND LIMITED QUANTITY INDEX: 0.12

ERAP INDEX: None

PASSENGER CARRYING SHIP INDEX: None

PASSENGER CARRYING ROAD VEHICLE OR PASSENGER CARRYING RAILWAY VEHICLE INDEX: 75

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 121 **NOTE:** Shipment of compressed gas cylinders via Public Passenger Road Vehicle is a violation of Canadian law (Transport Canada Transportation of Dangerous Goods Act, 1992).

15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:

U.S. SARA REPORTING REQUIREMENTS: This gas mixture is subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

COMPOUND	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
Dichlorodifluoromethane	NO	NO	YES
Trichlorofluoromethane	NO	NO	YES
1,1,2-Trichloro-1,1,2-trifluoroethane	NO	NO	YES

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for the components of this gas mixture. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.

U.S. TSCA INVENTORY STATUS: The components of this gas mixture are listed on the TSCA Inventory.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Dichlorodifluoromethane = 5000 lbs (2270 kg);. Trichlorofluoromethane = 5000 lb (2270 kg). The 1,1,2-Trichloro-1,1,2-Trifluoromethane component is a CERCLA Hazardous Substance which has no specific RQ assigned.

U.S. OTHER U.S. FEDERAL REGULATIONS:

- 1,1,2-Trichloro-1,1,2-trifluoroethane, Trichlorofluoromethane, and Dichlorodifluoromethane are subject to the requirements of CFR 29 1910.1000. These gases are listed on Table Z.1.
- No component of this gas mixture is subject to the reporting requirements of Section 112(r) of the Clean Air Act.
- 1,1,2-Trichloro-1,1,2-trifluoroethane, Trichlorofluoromethane, and Dichlorodifluoromethane are listed as Class I ozone-depleting chemicals. This gas mixture is required to bear the following label:
  Warning: Contains *Name of Chlorofluorocarbon*, a substance which harms public health and environment by destroying ozone in the upper atmosphere.
- Chlorodifluoromethane is subject to the reporting requirements under Title VI of the Clean Air Act Amendments of 1990: "Stratospheric Ozone Protection".
- The components of this gas mixture are not listed in Appendix A as a highly hazardous chemical, per 29 CFR 1910.119: Process Safety Management of Highly Hazardous Chemicals.
- Nitrogen, Oxygen, Tetrafluoromethane, 1,1,2-Trichloro-1,1,2-trifluoroethane, Trichlorofluoromethane, and Dichlorodifluoromethane are not listed as Regulated Substances, per 40 CFR, Part 68, of the Risk Management for Chemical Releases.

U.S. STATE REGULATORY INFORMATION: The components of this gas mixture are covered under the following specific State regulations:

Alaska - Designated Toxic and Hazardous Substances: Trichlorofluoromethane, Dichlorodifluoro-methane, 1,1,2-Trichloro-1,1,2-trifluoroethane.

California - Permissible Exposure Limits for Chemical Contaminants: Trichlorofluoromethane, Dichlorodifluoro-methane, Nitrogen, 1,1,2-Trichloro-1,1,2-trifluoroethane.

Florida - Substance List: Oxygen, Trichlorofluoromethane, Dichlorodi-fluoromethane, 1,1,2-Trichloro-1,1,2-trifluoro-ethane.

Illinois - Toxic Substance List: Trichlorofluoromethane, Dichlorodi-fluoromethane, 1,1,2-Trichloro-1,1,2-trifluoro-ethane.

Kansas - Section 302/313 List: No.

Massachusetts - Substance List: Trichlorofluoromethane, Dichlorodi-fluoromethane, Oxygen, 1,1,2-Trichloro-1,1,2-trifluoroethane.

Minnesota - List of Hazardous Substances: Trichlorofluoromethane, Dichlorodifluoromethane, 1,1,2-Trichloro-1,1,2-trifluoroethane.

Missouri - Employer Information/Toxic Substance List: Trichlorofluoromethane, Dichlorodifluoromethane, 1,1,2-Trichloro-1,1,2-trifluoroethane.

New Jersey - Right to Know Hazardous Substance List: : Trichlorofluoromethane, Dichlorodifluoromethane, Oxygen, Nitrogen, 1,1,2-Trichloro-1,1,2-trifluoroethane.

North Dakota - List of Hazardous Chemicals, Reportable Quantities: Trichlorofluoromethane, Dichlorodifluoro-methane.

Pennsylvania - Hazardous Substance List: Trichlorofluoromethane, Dichlorodi-fluoromethane, Oxygen, Nitrogen, 1,1,2-Trichloro-1,1,2-trifluoro-ethane.

Rhode Island - Hazardous Substance List: Trichlorofluoromethane, Dichlorodifluoromethane, Oxygen.

Texas - Hazardous Substance List: : Trichlorofluoromethane, Dichlorodi-fluoromethane, 1,1,2-Trichloro-1,1,2-trifluoroethane.

West Virginia - Hazardous Substance List: Trichlorofluoromethane, Dichlorodifluoro-methane, 1,1,2-Trichloro-1,1,2-trifluoro-ethane.

Wisconsin - Toxic and Hazardous Substances: Trichlorofluoromethane, Dichlorodifluoromethane, 1,1,2-Trichloro-1,1,2-trifluoroethane

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): No component of this gas mixture is on the California Proposition 65 lists.

ADDITIONAL CANADIAN REGULATIONS:

CANADIAN DSL/NDSL INVENTORY STATUS: The components of this gas mixture are listed on the DSL Inventory.

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: The components of this gas mixture are not on the CEPA Priorities Substances Lists.

CANADIAN WHMIS CLASSIFICATION: This gas mixture is categorized as a Controlled Product, Hazard Class A, as per the Controlled Product Regulations.

16. OTHER INFORMATION

INFORMATION ABOUT DOT-39 NRC (Non-Refillable Cylinder) PRODUCTS

DOT 39 cylinders ship as hazardous materials when full. Once the cylinders are relieved of pressure (empty) they are not considered hazardous material or waste. Residual gas in this type of cylinder is not an issue because toxic gas mixtures are prohibited. Calibration gas mixtures typically packaged in these cylinders are Nonflammable n.o.s., UN 1956. A small percentage of calibration gases packaged in DOT 39 cylinders are flammable or oxidizing gas mixtures.

For disposal of used DOT-39 cylinders, it is acceptable to place them in a landfill if local laws permit. Their disposal is no different than that employed with other DOT containers such as spray paint cans, household aerosols, or disposable cylinders of propane (for camping, torch etc.). When feasible, we recommended recycling for scrap metal content. CALGAZ, LLC will do this for any customer that wishes to return cylinders to us prepaid. All that is required is a phone call tomake arrangements so we may anticipate arrival. Scrapping cylinders involves some preparation before the metal dealer may accept them. We perform this operation as a service to valued customers who want to participate.

MIXTURES: When two or more gases or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an Industrial Hygienist or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

Further information about the handling of compressed gases can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102. Telephone: (703) 412-0900.

P-1 *"Safe Handling of Compressed Gases in Containers"*
AV-1 *"Safe Handling and Storage of Compressed Gases"*
"Handbook of Compressed Gases"

PREPARED BY:

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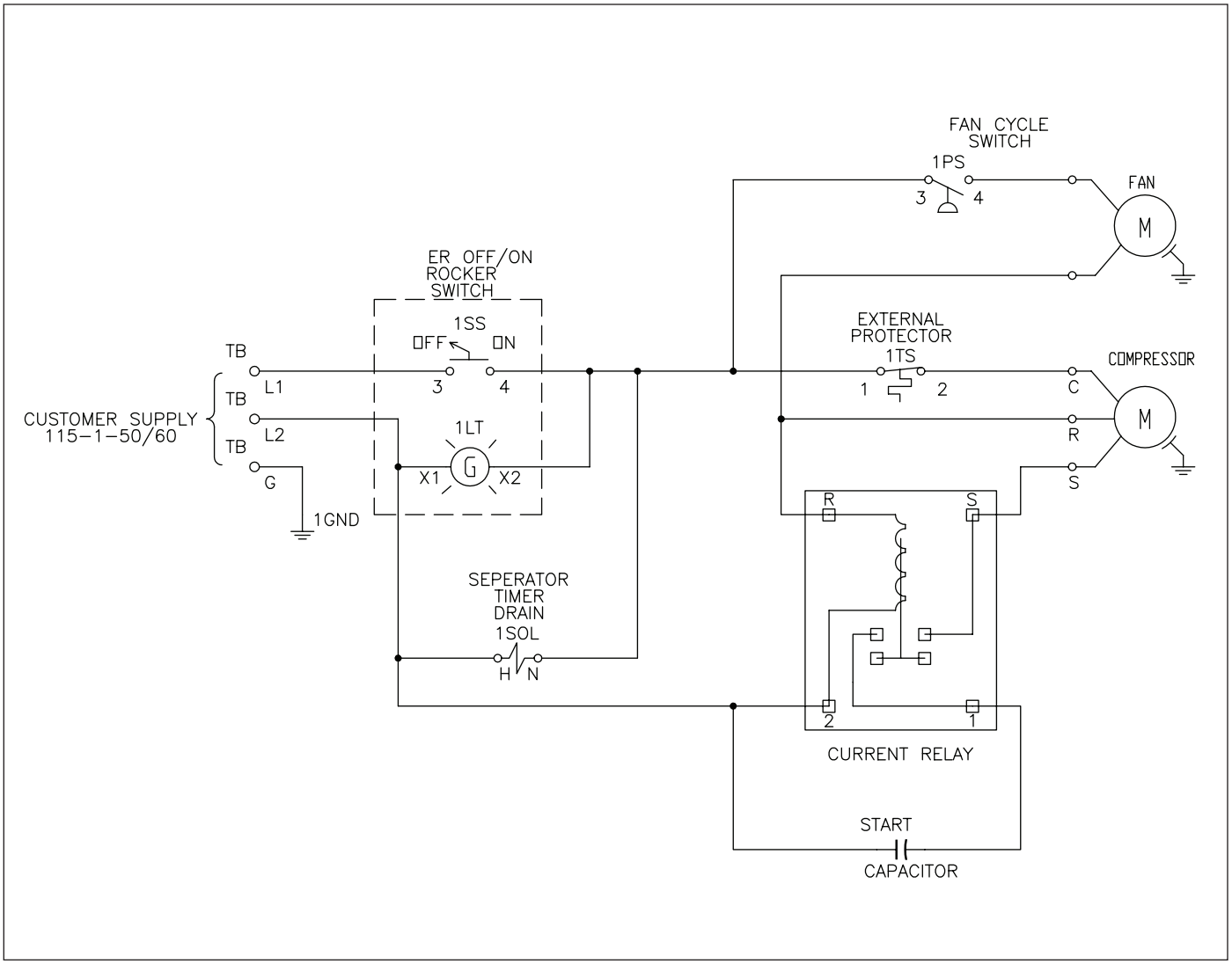
PO Box 3519, La Mesa, CA 91944-3519
619/565-0302

Fax on Demand: 1-800/231-1366

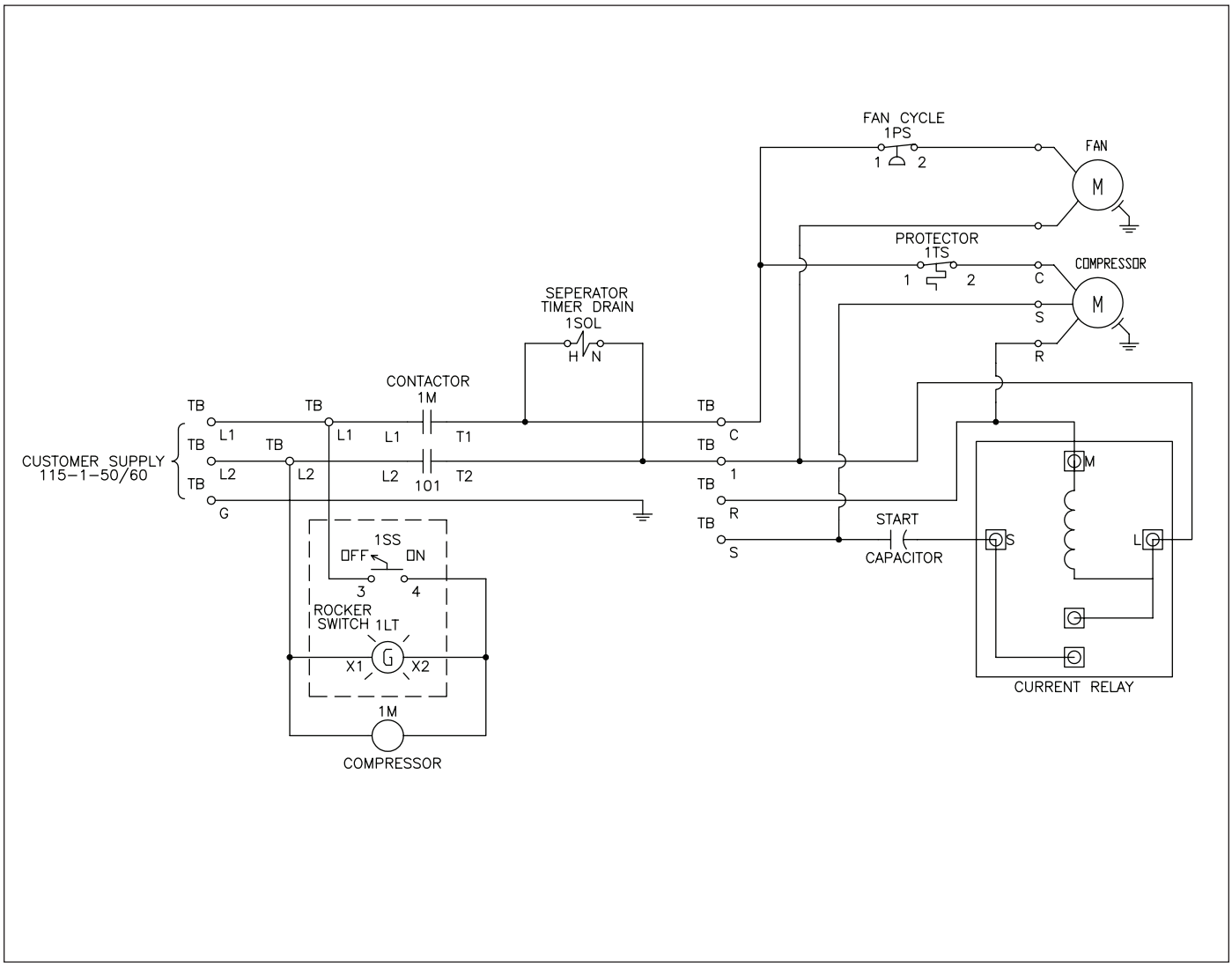
AIR LIQUIDE

This Material Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this gas mixture. To the best of CALGAZ, LLC's knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness are not guaranteed and no warranties of any type, either express or implied, are provided. The information contained herein relates only to this specific product. If this gas mixture is combined with other materials, all component properties must be considered. Data may be changed from time to time. Be sure to consult the latest edition.

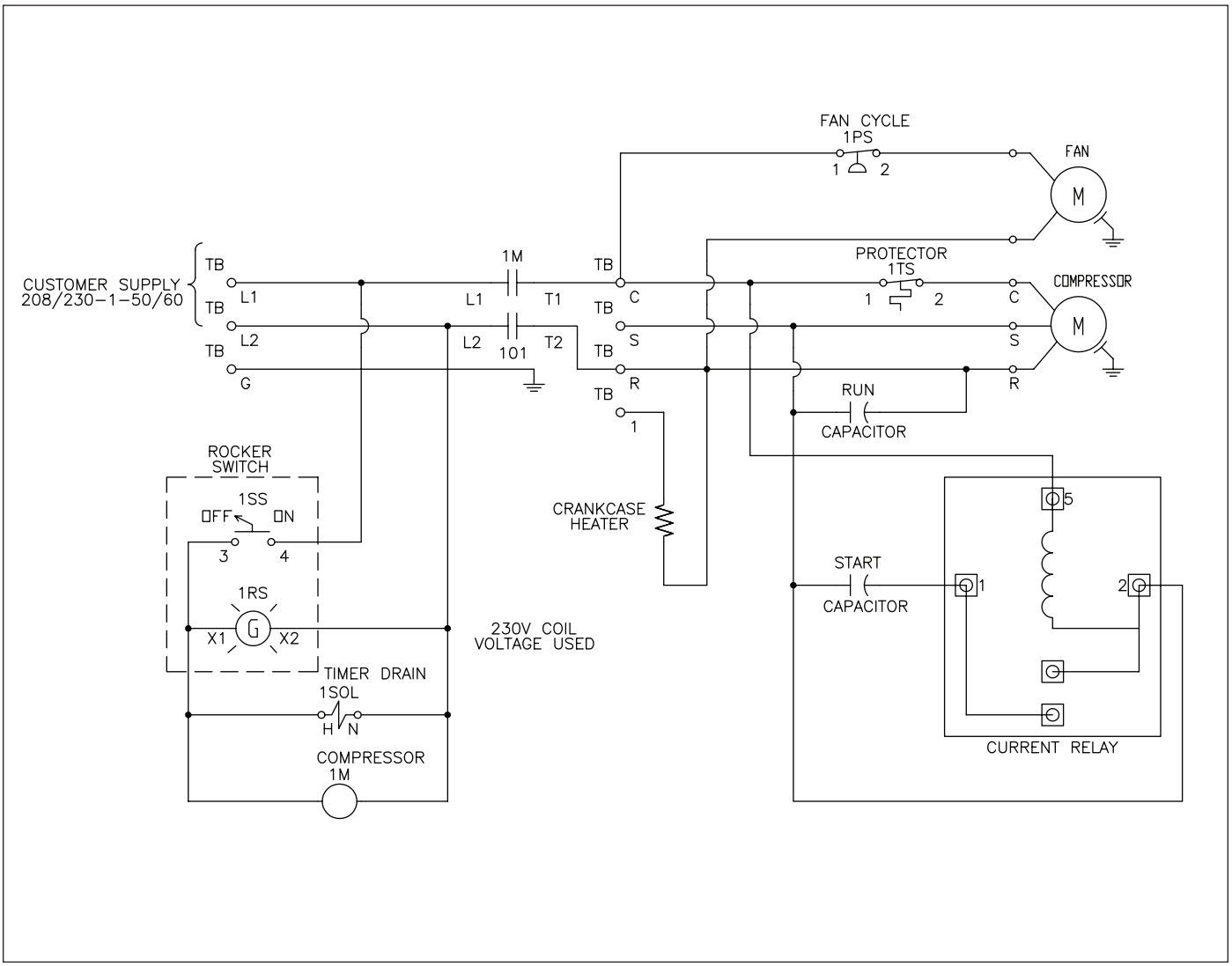
Wiring Diagram, SCFM Rated 20 to 50 Models: 1 Phase, 120 Volt, 60 Hz



Wiring Diagram, SCFM Rated 75 to 100 Models: 1 Phase, 120 Volt, 60 Hz



Wiring Diagram, SCFM Rated 125 Model: 1 Phase, 208/230 Volt, 60 Hz



Service Notes

Date	Service Performed	Notes

Service Notes, continued

Date	Service Performed	Notes

Service Notes, continued

Date	Service Performed	Notes

Aircel Compressed Air & Gas Warranty

Aircel warrants that its Standard Refrigerated Air Dryers are free from defects in materials and workmanship for two years from the date of invoice. Warranty coverage for this time period will be parts and labor for the first year and parts only for the second. Custom engineered products, desiccant dryers, chillers and nitrogen generators are warranted to be free from defects in materials and workmanship for one year from date of invoice. Warranty coverage for this time period will be for parts and labor.

Aircel warranty excludes damages due to corrosion, lack of proper maintenance, incorrect installation, modification, or misapplication of equipment. Routine maintenance or adjustment required under normal operation as outlined in the Aircel operation and maintenance manuals are not covered under warranty.

Once Aircel has been given adequate opportunity to remedy any defects in material or workmanship in accordance with Aircel Warranty Policy and Procedures, Aircel retains the sole option to accept return of the goods, with freight paid by the purchaser, and to refund the purchase price for the goods after confirming the goods are returned undamaged and in usable condition. Such a refund will be the full extent of Aircel liability. Aircel shall not be liable for any other costs, expenses or damages whether direct, indirect, special, incidental, consequential or otherwise. The terms of this warranty may be modified only by a special warranty document signed by a CEO, General Manager or Vice President of Aircel.

There exist no other representations, warranties or guarantees except as stated in this paragraph and all other warranties, including merchantability and fitness for a particular purpose whether express or implied, are hereby expressly excluded and disclaimed.

Parts and Service

For genuine Aircel replacement parts, call:

800-767-4599

www.AircelDryers.com

For faster service, have unit's model and serial number, part number, description, and quantity available.

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Aircel LLC. is a leading designer and manufacturer of dryer systems and components.

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Printed in USA
August 2013